CLAIMS

What is claimed is:

1. A method for separating at least two particles, the particles having different physical properties, the method comprising the steps of:

applying a light source to create a light intensity pattern;

exposing the at least two particles to the light intensity pattern producing force on each particle;

moving the light intensity pattern with respect to the at least two particles causing the at least two particles to move with the light intensity pattern at velocities related to their respective physical properties, wherein each of the at least two particles moves at a different velocity causing the at least two particles to separate.

2. The method according to claim 1, wherein the step of applying a light source further comprises interfering at least two optical light beams.

3. The method according to claim 2 wherein the at least two optical light beams are coherent light beams.

4. The method according to claim 2 wherein the at least two optical light beams are incoherent light beams.

5. The method according to claim 2 further comprising splitting one optical light beam to create the at least two optical light beams.

6. The method according to claim 1 wherein the step of applying a light source further comprises using an optical mask to create the light intensity pattern.

7. The method according to claim 6 wherein the optical mask comprises an amplitude mask.

8. The method according to claim 6 wherein the optical mask comprises a phase mask.

9. The method according to claim 6 wherein the optical mask comprises a holographic mask.

10. The method according to claim 1 wherein the step of applying a light source further comprises periodically dimming and brightening a plurality of light sources to create the light intensity pattern.

11. The method according to claim 1 wherein the light intensity pattern comprises at least two peaks.

12. The method according to claim 1 wherein the light intensity pattern comprises at least two valleys.

13. The method according to claim 1 wherein the light intensity pattern is sinusoidal.

14. The method according to claim 1 wherein the light intensity pattern is periodic but not sinusoidal.

15. The method according to claim 1 wherein the light intensity pattern is constant in time.

16. The method according to claim 1 wherein the light intensity pattern varies in time.

17. The method according to claim 1 wherein the light intensity pattern is periodic and the period is optimized to create separation between the at least two particles.

18. The method according to claim 1 wherein the light intensity pattern is fixed in space and the at least two particles are moved with respect to the light intensity pattern.

19. The method according to claim 1 wherein the light intensity pattern is moved in space.

20. The method according to claim 1 wherein the light intensity pattern is generated with coherent optical beams and the step of moving the light intensity pattern further comprises modulating the phase of the light beam(s).

21. The method according to claim 1 wherein the light intensity pattern is moved at a constant velocity.

22. The method according to claim 1 further comprising optimizing velocity of the light intensity pattern to cause separation based on the physical properties of the at least two particles.

23. The method according to claim 1 further comprises after allowing the at least two particles to separate, altering velocity of the light intensity pattern with respect to the at least two particles causing further separation of the at least two particles.

24. The method according to claim 1 wherein the light source has a wavelength of between 0.3μm and 1.8μm.

25. The method according to claim 24 wherein the wavelength is between 0.8μm and 1.8μm.

26. The method according to claim 25 wherein the wavelength is exactly or approximately 1.55μm.

27. The method according to claim 1 wherein at least one of the at least two particles have a resonant frequency and the light intensity pattern has a wavelength tuned to the resonant frequency of one of the at least two particles.

28. The method according to claim 1 wherein the light intensity pattern is two-dimensional.

29. The method according to claim 28 wherein the light intensity pattern has a period in each of the two dimensions and the period is different in each dimension.

30. The method according to claim 1 wherein the light intensity pattern is three-dimensional.

31. The method according to claim 30 wherein the light intensity pattern has a period in each of the three dimensions and the period is different in at least two of the dimensions.

32. The method according to claim 1 wherein the at least two particles are carried in a medium.

33. The method according to claim 32 wherein the medium is a fluidic medium.

34. The method according to claim 33 wherein the medium is non-guided.

35. The method according to claim 33 wherein the medium is guided.

36. The method according to claim 35 wherein the medium includes fluidic channels.

37. The method according to claim 1 further comprising the step of superimposing a gradient onto the light intensity pattern.

38. The method according to claim 37 wherein the gradient is spatially constant.

39. The method according to claim 37 wherein the gradient is spatially varying.

40. The method according to claim 37 wherein the gradient is temperature.

41. The method according to claim 37 wherein the gradient is pH.

42. The method according to claim 37 wherein the gradient is viscosity.

43. The method according to claim 1 further comprising the step of superimposing an external force onto the light intensity pattern.

44. The method according to claim 43 wherein the force is constant.

45. The method according to claim 43 wherein the force is varying spatially and/or temporally.

46. The method according to claim 43 wherein the force is magnetic.

47. The method according to claim 43 wherein the force is electrical.

48. The method according to claim 43 wherein the force is gravitational.

49. The method according to claim 43 wherein the force is fluidic.

50. The method according to claim 43 wherein the force is frictional.

51. The method according to claim 46 wherein the force is electromagnetic.

52. The method according to claim 1 further comprising the step of monitoring separation of the at least two particles.

53. The method according to claim 52 further comprising providing feedback regarding particle separation.

54. A system for separating at least two particles, the particles having different physical properties, the system comprising:

means for creating a light intensity pattern in the vicinity of the at least two particles; and

means for moving the light intensity pattern with respect to the at least two particles.

55. The system according to claim 54, wherein the means for creating a light intensity pattern comprises a light source for producing two light beams aimed to interfere with each other in the vicinity of the at least two particles.

56. The system according to claim 55, wherein the light beams comprise coherent light beams.

57. The system according to claim 54, further comprising a beam splitter and a reflector, wherein the light source is configured to produce a light beam aimed at the beam splitter, the beam splitter is configured to split the light beam into a first light beam

directed toward the at least two particles and a second light beam directed toward the reflector, the reflector is configured to redirect the second light beam toward the at least two particles such that the first and second light beams interfere creating a light intensity pattern in the vicinity of the at least two particles.

58. The system according to claim 57, wherein the means for moving comprises an actuator connected to the reflector for moving the reflector.

59. The system according to claim 57, wherein the means for moving comprises an actuator connected to the light source and beam splitter for moving the light source and beam splitter.

60. The system according to claim 55, wherein the means for moving is configured to move the light intensity pattern in space.

61. The system according to claim 55, wherein the means for moving is configured to move the light intensity pattern in time.

62. The system according to claim 55, wherein the means for moving is configured to fix the light intensity pattern and move the at least two particles in space relative to the light intensity pattern.

63. The system according to claim 62 wherein the at least two particles are held on a slide and the means for moving comprises an actuator for moving the slide relative to the light intensity pattern.

64. The system of claim 55 wherein the means for moving comprises a phase modulator for modulating the phase of one of the two light beams with respect the other.

65. The system of claim 57 further comprising a phase modulator positioned in the path of the first light beam, the phase modulator configured for modulating the phase of the first light beam with respect to the second light beam.

66. The system of claim 57 further comprising a phase modulator positioned in the path of the second light beam, the phase modulator configured for modulating the phase of the second light beam with respect to the first light beam.

67. The system of claim 54 wherein the means for moving comprises an amplitude modulator configured for modulating the amplitude of at least one of the light beams, first light beam, or second light beam.

68. The system of claim 55 wherein the light source comprises a laser.

69. The system of claim 55 wherein the light beam is between 0.3μm and 1.8μm.

70. The system of claim 55 wherein the light beam is between 0.8μm and 1.8μm.

71. The system of claim 55 wherein the light beam has a wavelength of 1.55μm.

72. The system of claim 54 wherein the means for creating a light intensity pattern comprises a light source and an optical mask, which can be a phase mask, an amplitude mask, or a holographic mask, the light source being configured for producing a light beam directed through the optical mask toward the at least two particles.

73. The system of claim 72 wherein the means for moving comprises an actuator connected to the light source and optical mask for moving the light source and optical mask.

74. The system of claim 72 wherein the optical mask is configured for producing a moving light intensity pattern in the vicinity of the at least two particles.

75. The system of claim 72 further comprising a phase modulator positioned in the light beam path and configured for modulating the phase of the light beam.

76. The system of claim 55 further comprising a plurality of light sources positioned adjacent to each other for producing a plurality of light beams directed toward the at least two particles for creating a light intensity pattern.

77. The system of claim 76 further comprising an actuator for moving the plurality of light sources.

78. The system of claim 76 wherein the plurality of light beams are aimed to slightly overlap each adjacent light beam in the vicinity of the at least two particles, the plurality of light sources being configured to be dimmed and brightened in a pattern for creating a moving light intensity pattern.